

## Introduction

The pumping system is utilized in our designed turbidostat to insert LB to our cell culture and to extract waste from it to maintain perfect culture conditions, as well as for a future dosing of the levothyroxine. Therefore, performing a proper calibration before using the pump is crucial for precise dosing and pumping. The calibration aims at knowing how much liquid (in our case LB or levothyroxine diluted liquid) is moved in a certain interval of time, so that we can previously program it to meet the set values. The volume of liquid pumped during this cycle (calibration volume) should be measured precisely. It is important to note that the calibration should be done under the same conditions at which the pumps will be used later.

## Materials

- Peristaltic pump 12V DC
- ~70 mL LB medium
- Electronic circuit (*see electronics module in Hardware page*)
- Two test tubes (*Note: one for the input medium and the other for the output waste*)

## Procedure

First of all, since the turbidostat is intended to pump in and out the LB medium, it is important to have it previously prepared (around 70 mL) under sterile conditions. All the medium will be placed in a test tube while the second one, 'waste tube', will be empty. Each of the peristaltic pump tubes is inserted on its corresponding tube. The idea is that when external power is applied to the electronic circuit, the pumps are activated, that is, the motor starts rotating and thus, forcing the liquid to move through the tube. The activation and deactivation of the pumps is controlled from the Arduino UNO board by a PWM output equal to 244. Remember that PWM (Pulse Width Modulation) allows you to generate analog outputs from digital pins.

One thing to consider is that the peristaltic pump tube needs to be completely filled with liquid so as to perform a proper measurement. Our drylab team decided to activate the pump during 10 seconds for the measurement. They considered that it was a reasonable amount of time and enough to move forward a measurable amount of liquid. After these 10 seconds, the pumps are deactivated and the volume of liquid inputted in the empty test tube is measured. This process is repeated several times and the average value is obtained.

## Results

TRIAL	Flow (mL/min)
1	56
2	52
3	55
4	55
5	54
6	55
7	54
8	55
9	56
10	56
<b>Average</b>	<b>55</b>

*Table1: characterization of our peristaltic pumps flow rate*

The results showed that our peristaltic pumps have a mean flow rate of 55 mL/min. Therefore, so as to control the volume of LB to be inserted and the volume of waste to be extracted, the pumps are activated along a pre-fixed time interval, taking into account the flow rate.